



UNITED STATES
DEPARTMENT OF TRANSPORTATION

Nationwide Differential GPS (NDGPS), Civil Signal Monitoring, and GPS Adjacent Band Compatibility Assessment

Space-Based PNT Advisory Board Meeting

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Future of NDGPS Assessment

Contributing factors driving assessment:

- Coast Guard changes in policy to allow aids to navigation (ATON) to be positioned with a GPS receiver using Receiver Autonomous Integrity Monitoring (RAIM)
- Increased use of Wide Area Augmentation System (WAAS) in commercial maritime applications
- Limited availability of consumer-grade NDGPS receivers
- No NDGPS mandatory carriage requirement on any vessel within U.S. territorial waters
- May 1, 2000 Presidential Directive turning off GPS Selective Availability
- Continuing GPS modernization
- The Federal Railroad Administration's determination that NDGPS is not a requirement for the successful implementation of Positive Train Control



Analysis - Future NDGPS Investment Decisions

- Joint DHS/USCG and DOT/RITA *Federal Register* Notice (FRN) Request for Public Comments [78 FR 22554; April 16, 2013]
 - Public comment period closed July 15
 - Docket still open for additional comments
 - USCG–2013–0054; RITA–2013–0001
- Outreach to User Community
 - FRN announcement/articles in trade press
 - Distribution to known interested parties
 - Distribution via CGSIC lists and GPS.gov
- USG Requirements Assessments
 - USCG all elements (e.g., ATON, small boat)
 - DOT all elements (e.g., surface, maritime)
 - All USG agencies via the National Space-Based PNT Executive Committee/Executive Steering Group (ESG) and DOT Extended Pos/Nav Executive Committee and Working Group



Comments/Information Sought

- Asked the following questions of interested members of the public; and Federal, state and local agencies;
 - (1) To what extent do you use the NDGPS in its current form for positioning, navigation, and timing?
 - (2) What would be the impact on NDGPS users if the NDGPS were to be discontinued?
 - (3) If NDGPS were to be discontinued, what alternatives can be used to meet users' positioning, navigation, and timing requirements?
 - (4) What potential alternative uses exist for the existing NDGPS infrastructure?



Summary of FRN Responses

- Much less feedback than expected
- Not all was negative
- Maritime Pilots' Associations & International
 - Maritime pilots - mooring operations
 - Focused on major US ports
 - Concerns for impact on aims of e-navigation
- State/Local DOTs, Surveyors, Private Sector
 - Survey, mapping, GIS and data sets, coastal and maritime navigation and environmental applications
 - Highway design and monument integrity
 - NOAA/NGS Continually Operating Reference Stations (CORS)



USG Responses

- U.S. Coast Guard (USCG)
 - No USCG requirement for NDGPS on USCG or commercial vessels, or for any other mission
 - No International Maritime Organization (IMO) requirement for carriage of a DGPS system
- U.S. Department of Transportation
 - No Federal Railroad Administration requirement for NDGPS to implement Positive Train Control
 - No St. Lawrence Seaway requirement for NDGPS for navigation
 - No requirements identified by any DOT Operating Administration
- Other USG Agencies
 - No mission requirements identified for NDGPS
 - Specific concerns for loss of CORS: density and site-specific
 - Dependencies identified for space weather and severe weather modeling and operations



Next Steps

- Identify and assess alternatives
 - Technical assessments of impacts of alternatives
 - Cost assessments of alternatives/use cases
 - Requires site-by-site assessment as well as systemic
 - Need to include costs for various scenarios:
 - Continuation/partial continuation/phased continuation
 - Partial/staged decommissioning – by site/use cases
 - Transfer to other parties
 - Hybrid alternatives
 - Ongoing O&M; environmental assessment and remediation; deconstruction; cost/benefit assessments
- Decision timeline: NET Summer 2014
 - Support FY16 budget request (implement NET FY16)
 - Existing O&M budgets (USCG and DOT) cannot support deconstruction and site remediation, especially if continuing service
 - Support planning/decision processes within USCG and USDOT



Benefits of Civil GNSS Signal/Service Monitoring

ICG Principle of Transparency

“Every GNSS provider should publish documentation that describes the signal and system information, the policies of provision and the minimum levels of performance offered for its open services”

Civil GNSS Signal/Service Monitoring provides:

1. The ability to verify commitments to GNSS performance
2. Improve situational awareness for the GNSS operators
 - Verify objectives and thresholds are being met
 - Identify potential for future improvements
3. Provide assurance that civil service failures are detected and resolved promptly



Rationale for Development of the GPS Civil Monitoring Performance Specification (CMPS)

- Identify civil requirements for monitoring of the GPS signals/service
- Identify metrics that address performance measures
 - Reference authoritative documents whenever possible
 - Described in USG policy statements, and
 - Derived from GPS interface specifications (IS)
- Address current capabilities and those in development
 - L1 C/A, L2C, L5, L1C
- Addresses both Standard Positioning Service (SPS) and Signal-in-Space (SIS)



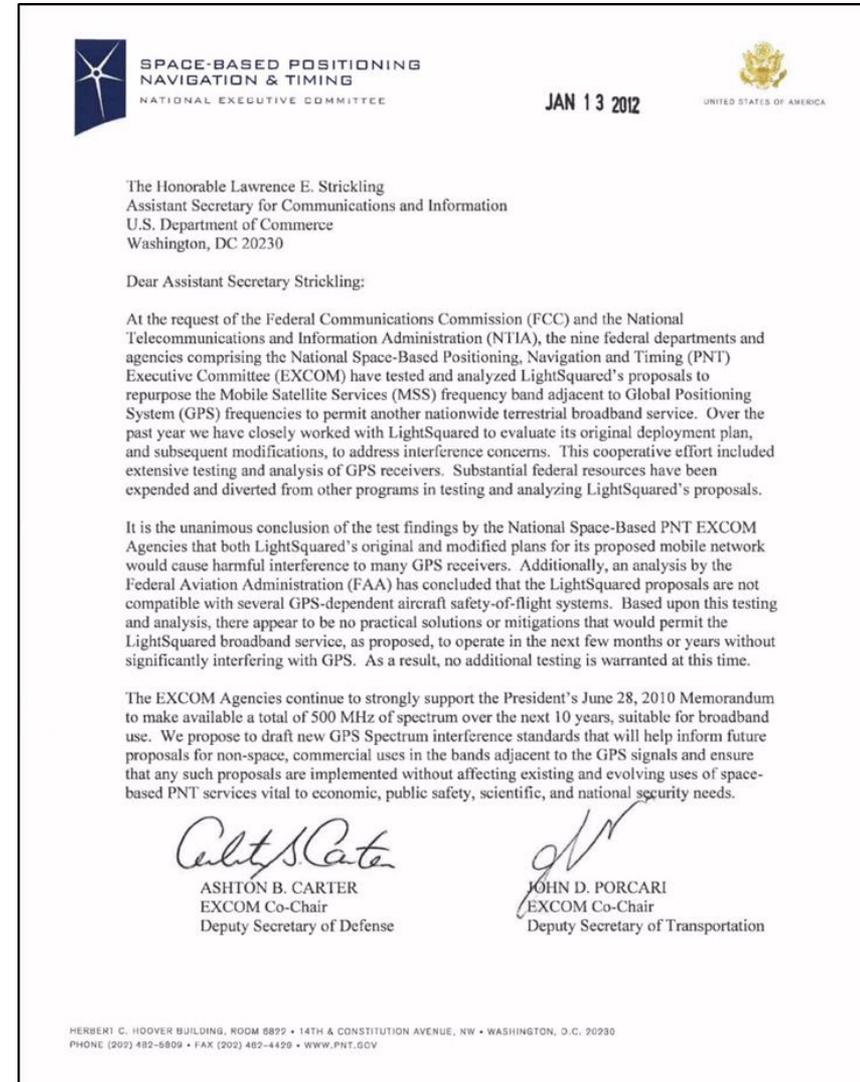
CMPS Overview and Implementation

- Monitoring Requirements; three categories
 1. System performance monitoring (35 requirements)
 - Derived from SPS PS and Federal Radionavigation Plan
 - Verification availability, reliability, and accuracy
 2. Signal monitoring (136 requirements)
 - Primarily derived from the ICDs and ISs
 3. Non-broadcast data (4 requirements)
- Infrastructure Requirements; reporting & archiving (18 reqts)
- Current version of CMPS publicly released on April 30, 2009
 - Available at <http://www.gps.gov>
- Implementation taking place in phases
 - SPS PS being assessed by FAA through Performance Analysis (PAN) reports <http://www.nstb.tc.faa.gov/DisplayArchive.htm> - Since 1999
 - DOT and USAF coordinating to implement in the Next Generation Operational Control System (OCX)



January 2012 Space-Based PNT EXCOM

- January 13, 2012 National Space-Based Positioning, Navigation, and Timing (PNT) Executive Committee (EXCOM) co-chair letter to National Telecommunications and Information Administration (NTIA) proposed to draft new Global Positioning System (GPS) spectrum interference standards:
 - Inform future proposals for non-space, commercial uses in the bands adjacent to the GPS signals.
 - Ensure such proposals are implemented without affecting existing and evolving uses of space-based PNT that are vital to economic, public safety, scientific, and national security needs.



DOT GPS Adjacent Band Compatibility Assessment

- Deputy Secretary Tasking to FAA and RITA:
 - Collaborate to develop a spectrum protection plan which provides a framework to define the processes and assumptions for development of GPS spectrum protection criteria on behalf of GPS civil users.

- GPS Adjacent Band Compatibility Assessment will identify the processes for:
 - Deriving adjacent-band power limits, as a function of offset frequency, necessary to ensure continued operation of all applications of GPS services.
 - Determining similar levels for future GPS receivers utilizing modernized GPS and interoperable Global Navigation Satellite System (GNSS) signals.



Near-Term Focus

- Frequency Bands Adjacent to GPS L1
 - Focus on an LTE concept
- Leverage Receiver Categories from TWG
 - Aviation*
 - Cellular
 - General Location/Navigation
 - High Precision
 - Timing
 - Networks
 - Space

*Certified avionics to be addressed by RTCA

- ❖ Develop a set of curves demonstrating the maximum aggregate power level as a function of frequency offset from GPS



Next Steps

- Engage with GPS Receiver Manufacturers (Initial Meeting held in September)
 - Receiver Filter Characteristics
 - Receiver Application Areas
 - User Interaction Scenarios
 - Transition Timeline for Receivers for Each Application
 - Interference Mask Development
 - Future Direction for GPS/GNSS Receiver Development
- Effort being worked in conjunction with DOT Extended Pos/Nav Working Group and GPS Directorate

